

Mr. Howard. at right angles from the proper station and plus on the preliminary line; the bearing of each tangent, by protractor, which should be the calculated bearing of the tangent as run in on the ground; the central angle of each curve, being the difference between the bearings of tangents; and the length of each tangent and curve; the last, when measured on the projection, being a check on the central angles. Then the location should be run in continuously from one end. A small correction will usually be made at the beginning of each curve, or of each curve and tangent, to compensate for the error up to that point and make the line check out ahead; but no part of the line will be run over again unless the divergence from the projection is great enough to be material. For small differences, say in general less than 5 ft., it will not be necessary to re-run the line; as it is generally difficult to determine, on location, before the line has been carefully cross-sectioned, and quantities accurately balanced, whether or not such a shift will hurt the line. In flat country a divergence of more than 5 ft. from the projection is generally allowable. The correction at the beginning of each curve is the simplest. A blank stake is driven at the point designated for the P. C. by the notes of the projection. If the tangent misses this point by say 4 ft., multiplying the cotangent of the central angle of the curve to be run by 4 ft. gives the distance that the P. C. must be moved backward or forward on the tangent so as to check out on the tangent ahead. Corrections at the beginning of tangents can also be made very readily by a transitman who is good at figures by slightly changing the length of the curve. This, however, changes the bearing of the tangent and the length of the curve ahead, and requires a little more figuring. The same may be said of a correction at a P. C. C. on a compound curve. It is very important that the calculated bearings of the location should check with those of the preliminary survey. If there is a difference of say 15 minutes between the calculated bearings of the preliminary and the location lines the transitman will find his line continually diverging from his projected line in one direction. Consequently, he should "angle" across to a preliminary hub occasionally, to check his calculated bearings by the calculated bearings of the preliminary; and if there is a difference, he should, for running purposes, correct the bearings of the location to check with those of the preliminary. The position, or "ties," of every P. C., P. C. C. and P. T. should be carefully noted on the right-hand page of the transit book, with reference to the preliminary line and at right angles thereto, thus:

85+92.3 P. T. (24 L 94+76 prelim.).

This information is necessary, in order to draw the actual location on the sheets.

In the writer's opinion, as a general rule, the method of running tangents to an intersection should not be used. It is attended with difficulties, and is often impracticable in the mountains. The intersection point is likely to be across a mountain, or on the other side of a river, if not in the middle of the stream. The object to be attained by the whole method is that the engineer can select and lay out the best location on paper, both as to line and profile; and, by his notes of projection, run the same line continuously on the ground from one end to the other in the shortest possible time, and with nearly the same accuracy as if the whole had been calculated by latitudes and departures.

EMILE LOW, M. AM. SOC. C. E. (by letter).—The writer has had considerable experience in railroad location, especially on the Mexican Central; Pittsburg, McKeesport and Youghiogeny; Pennsylvania; Schuylkill Valley, and the Norfolk and Western Railroads. Methods similar to those outlined by Mr. Lavis were used on these roads.

The writer, however, desires to take issue with the author for his preference for roll maps, and agrees with Wellington, that separate sheets have many advantages, especially in camp, where the drafting facilities are not always of the best. The so-called protractor sheets are found to be very convenient in this respect, the writer preferring the 19 by 24-in. sheets, on Weston's Linen Record paper, which is a commercial size. He also prefers to orient the sheets, the edges being kept absolutely north and south, or east and west, as may prove most practicable.

For field use, these sheets have much to commend them. They can be readily carried in a convenient wooden portfolio, which also answers as a drawing board. On the roads mentioned, the scale generally used was 200 ft. to 1 in., so that a sheet covered about a mile of line.

For office use, these sheet maps were traced in sections of convenient length, or, in cases where the line was more or less direct, an entire division could be shown in one tracing. In this way the advantages of both sheet maps and roll maps could be combined.

Mr. Whinery aptly makes this statement: "It may be safely asserted that there are in this country a surprisingly large number of railroads located so badly that * * *."

In another place he also makes this statement: "The up-to-date way is only scientific; the old way belonged to a higher order—it savored of Genius."

It is far from the writer's intention to make any invidious comparisons, but he would venture the assertion that many of these badly located railroads can be traced to the Geniuses mentioned, and the present generation of engineers is kept busy correcting the mistakes of a former one.